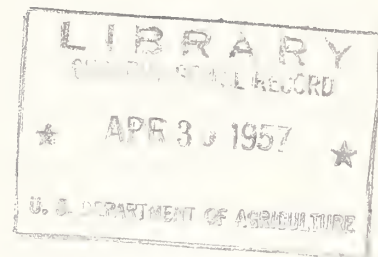


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Summary of Current Research Work on

PACKAGING AND CONTAINERS

in U. S. Dept. of Agriculture

UNITED STATES DEPARTMENT OF AGRICULTURE

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OUTLINE AND INDEX

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USDA AGENCY ABBREVIATIONS

MRD-1C - Marketing Research Div., AMS - Biological Sciences Branch
MRD-MD - Marketing Research Div., AMS - Market Development Branch
MRD-TF - Marketing Research Div., AMS - Transportation & Facilities Branch
ARS-NU - Agricultural Research Service - Northern Utilization Branch
ARS-WU - Agricultural Research Service - Western Utilization Branch
FS - Forest Service

Summary of Current Research Work on

PACKAGING AND CONTAINERS

In U. S. Department of Agriculture 1/

I. PRODUCT REQUIREMENTS

1. Packaging Requirements for Frozen Bread

ARS-WU

In studies on the preservation by freezing of commercial bakers' bread, particular attention was paid to the relationship between type of packaging and freezing and defrosting. If unwrapped bread were to be frozen commercially, it would have to be wrapped soon after freezing to avoid excessive moisture loss during subsequent storage and defrosting. Frozen bread can be defrosted at temperatures up to 120°F. without damage to the bread or wrapper, provided the relative humidity of the air outside the wrapper is low enough to prevent damage to the wrapper by excessive condensation of water.

Studies on the preservation of bread by freezing have been completed. Similar work is being extended to other baked goods.

2. Frozen Poultry

ARS-WU

Environmental requirements of frozen, ready-to-cook poultry have been investigated as a part of the basic studies on the effect of product type, temperature, time, and processing conditions on the final quality. These studies have shown that storage of turkeys at 0°F. for at least 1 year requires a moisture-impermeable barrier closely adhering to the poultry surface.

These studies are being continued.

3. Precooked Frozen Poultry Products

ARS-WU

Studies on precooked frozen creamed turkey, turkey dinners and pies, and fried chicken have shown the importance of adequate packaging protection in maintaining flavor stability during storage.

Packaging materials that are suitable for use with precooked frozen poultry must effectively exclude air from the product. An additional requirement in many cases is that they be suitable for use in reheating the frozen product in preparation for serving.

Similar studies are being extended to other precooked frozen poultry and egg products.

1/ Prepared by USDA Working Group on Packaging and Containers. Inquiries can be addressed to J. Roy Allgyer, Chairman, Packaging and Container Working Group, U. S. Department of Agriculture, Washington 25, D. C.

4. Preservation of Shelled Walnuts

ARS-WU

Work has been continued on the investigations designed to determine some of the interdependent effects of light, moisture, oxygen, heat, and high energy radiations on the stability of shelled walnut kernels. A study has been completed on the combined effects of light, moisture, and antioxidant coatings on the stability of kernels held when ambient temperatures are 65° to 100°F.

The effects of high energy radiations (3 MEV cathode and gamma rays from a cobalt source) on the stability of shelled kernels were investigated in a cooperative experiment with the Massachusetts Institute of Technology.

It is hoped to make similar studies to devise means for stabilizing other commercially important shelled nuts.

5. Packaging Requirements for Potato Granules

ARS-WU

Foremost among the problems of handling potato granules (mashed potato powder) is the development of economical methods of controlling rancidity, or oxidative deterioration.

While oxidative deterioration can be controlled by packaging the product in an atmosphere which is free of oxygen, packaging materials with sufficiently low permeability to oxygen are very expensive and they add very markedly to the cost of the finished product.

6. Packaging Requirements for Fruit Juice Powders

ARS-WU

Fruit juice powders are produced by vacuum puff-drying and contain about 3 percent moisture at the time of packaging. It is necessary to perform the packaging operation in a room at low relative humidity (about 8 percent R.H.) because of the hygroscopic nature of these powders. Maximum stability is achieved when the final moisture content is 1 percent or less.

Studies are continuing in an effort to develop economical processes that will yield powdered products with still greater stability, particularly pineapple juice powder.

II. DEVELOPMENT AND EVALUATION OF CONTAINERS IN TERMS OF

A. Maintenance of Quality of the Product

1. Transit Refrigeration of Peaches in Various Containers and Loading Patterns

MRD-BSB

Refrigeration in new alternately inverted crosswise offset loading method was found as effective as in other loading patterns. Two new-type ventilated fiberboard cartons, one approximately the size of the 18-pound lug and the other a $\frac{1}{2}$ -bushel tub with fitted lid, cooled more rapidly than the lengthwise conventional wooden lug box load.

Further work on similar studies with Colorado peaches is being considered for the 1957 season.

2. Packaging, Precooling, and Shipping California Peaches at Optimum Maturity

MRD-BSB

Tests were initiated during the summer of 1956 to determine the effects of different types of pads, liners, and other protective packaging materials on physical damage to well-matured freestone peaches packed in wooden lugs and shipped by rail to eastern markets.

The work will be continued and expanded to further test the materials tried, and to evaluate additional packaging materials and experimental containers for maintaining quality of peaches and nectarines.

3. Fiberboard Cartons as Containers for Florida Citrus

MRD-BSB

Four-fifth-bushel fiberboard cartons are being extensively used as shipping containers for citrus, as they are cheaper than wooden crates. A serious problem in connection with this shift of containers is the difficulty of cooling warm oranges in cartons.

Citrus shipping tests in which cartons are used will be continued. Package design and loading patterns which permit more rapid cooling will be given special attention.

4. Crates and Cartons for Overseas Shipments of Florida Citrus

MRD-BSB

At the request of the Florida Citrus Mutual and Florida Citrus Exchange, overseas shipping tests and simulated overseas shipping tests with grapefruit and oranges were conducted. Decay development was retarded by the use of biphenyl. The best control of decay during simulated shipments was with the use of biphenyl-treated paper in fiberboard cartons; the least control was from its use in wirebound crates. A Dowicide-A+Hexamine treatment before packaging was quite effective in checking decay in Valencia oranges in wirebound crates, but the control of decay was not greatly improved when fruit treated with this compound was packed in crates with biphenyl-treated liners.

The overseas type of telescope carton held up satisfactorily for a short period but failed (probably because of moisture absorption) toward the end of an 8-week holding period when the packages were rehandled several times.

Further overseas shipping or simulated shipping tests are planned and will include a comparison of containers and decay inhibitors whenever possible.

5. Performance of Fiberboard Boxes for Apple Storage

MRD-BSB

Fiberboard boxes are being used increasingly for packing apples in the Northwest but most are not strong enough for a full season's palletized storage. A pallet load of apples packed in one type of fiberboard boxes supported 2 additional pallet loads of apples for 4 months in cold storage without box failure or bruising of the fruit. The apples were place-packed as in the standard wooden box without trays or cells.

No additional tests are contemplated for the next apple storage season.

6. Waxing and Consumer Packaging of Potatoes

MRD-BSB

In 1956, 96 10-pound kraft and polyethylene bags of potatoes, half waxed and half nonwaxed, were shipped from Maine to Washington, D. C., and then held at either 40° or 70°F. for evaluation. During the 10-day period from loading to unloading, there were no differences in weight loss or extent of decay between waxed and nonwaxed lots.

Sprouting and decay of consumer-packaged potatoes held at 70°F. were no higher in polyethylene bags than in kraft bags.

A report will be prepared next year combining the potato waxing and packaging studies completed by the Department in Maine, North Carolina, and the Red River Valley region.

7. Transit Refrigeration of California Potatoes in Various Containers MRD-BSB

With the cooperation of the University of California, a transportation test was conducted to study the refrigeration requirements of potatoes in two types of containers not previously tested; namely, 50-pound cartons and 10-pound paper-mesh window bags. Potatoes cooled much more slowly in transit in cartons and consumer bags than in regular 100-pound burlap bags. However, half-stage standard refrigeration provided adequate protection for potatoes in cartons and a modified half-stage icing with initial ice after loading and two reicings in transit were sufficient for potatoes shipped in 10-pound consumer bags and in regular 100-pound burlap bags. This service costs \$19 less than half-stage standard refrigeration.

Further tests are desired by the shippers to determine the best protective services for new potatoes in different containers.

8. Containers and Shipping Methods for Mature-Green California Tomatoes

MRD-BSB

Most California tomatoes are shipped in wooden lug boxes holding about 35 pounds of fruit, but various substitute fiberboard cartons are being introduced. Tests were made to determine the transit temperature and carrying quality of mature-green tomatoes in the regular lug box and in 35- and 50-pound cartons.

Additional tests will be made with different load patterns and other shipping containers to determine their effect on transit temperatures and quality maintenance. Tests with turning-ripe tomatoes also will be included.

9. Retention of Market Quality in Frozen Turkeys as Related to Packaging and Shipping Containers

MRD-BSB

Preliminary studies showed that processing and packaging practices in use are responsible for some loss in quality of frozen turkeys during marketing. Investigations were initiated to learn the extent of quality changes due to packaging and shipping containers while frozen turkeys move from the processor to the storage warehouse, to the distributor, and to the retailer.

Further work will be directed toward measuring the nature and amount of deterioration of frozen turkeys in marketing channels and methods of preventing this deterioration.

10. Ice-Packed Poultry in Fiberboard Containers

MRD-BSB

Studies of quality changes of ice-packed poultry in fiberboard cartons and in wirebound crates during marketing were initiated. Preliminary tests with the fiberboard shipping containers showed them to be resistant to water and capable of standing up in truck shipments from the poultry processing plant to the jobber and to the retail store.

Emphasis in the coming year will be on the nature and number of bacteria, yeasts, and molds on ice-packed poultry in wirebound crates and fiberboard cartons.

11. Prevention of Mechanical Damage to Fruits and Vegetables

MRD-BSB

The results of a Federal Civil Defense Administration food test conducted in 1955 at the Nevada Test Site of the Atomic Energy Commission were reported last year.

The project has been discontinued.

12. Film Liners and Paper Laminates of Polyethylene for Stored Western-Grown Golden Delicious Apples

MRD-BSB

Serious attention should be given to some means of protecting loose-stored Golden Delicious apples from excessive moisture loss before packing. Loose fruit lost nearly as much weight (2 percent) during the first 30 days of storage as that packed in polyethylene did during an entire storage season of 194 days.

The appearance and condition of Golden Delicious apples when held for late marketing, were greatly improved by packing in polyethylene. Equally good results were obtained from polyethylene in the form of film box liners, laminated paper liners, or laminated fiberboard cartons.

No further work is contemplated on this project.

13. Storage of California Yellow Newtown Apples in Sealed Film Liners MRD-BSB

Experiments were continued with sealed polyethylene box liners for Yellow Newtown apples which are subject to internal browning at low temperatures. Results in 2 previous years had indicated that sealed 1.5-mil polyethylene box liners could be used to advantage for storing this variety at 40°F. Results during the past season were not favorable because of oxygen concentrations within the sealed packages which were below those required for normal respiratory processes. Apparently the polyethylene used was considerably less permeable to O₂ and CO₂ than that used in previous years.

This season's unsatisfactory results indicate the need of further research to establish permeability requirements and to relate such requirements to film specifications.

14. Polyethylene Box Liners for Storage of Eastern-Grown Apples

MRD-BSB

Studies at Beltsville with polyethylene film box liners were continued to evaluate them further for maintaining quality in storage. Sealed polyethylene-150 box liners markedly reduced scald of Rome Beauty, Arkansas, Grimes Golden, and Jonathan apples stored at 31°F. The best control of scald was obtained when oiled wraps were used in conjunction with sealed film liners.

Film liner studies will be continued with these varieties, using polyethylene film of several different densities and permeabilities.

15. Sealed Polyethylene Box Liners Control Soft Scald of Apples

MRD-BSB

Complete control of soft scald of Jonathan apples by packaging in sealed polyethylene liners was reported last year. The value of these results was recognized when approximately 25,000 boxes of Jonathan apples were packed commercially in the Pacific Northwest in sealed polyethylene in 1955. Soft scald was also controlled this past season in sealed experimental poly packs of Delicious apples.

Another season's work is contemplated to determine the effectiveness of sealed poly liners in controlling soft scald in two other susceptible varieties--Winesap and Golden Delicious.

16. Polyethylene Liners for Packaging Studies on Pears

MRD-BSB

Converters of polyethylene recently developed a new, easier-handling type of polyethylene called "high slip." Similar oxygen and carbon dioxide concentrations were found in boxes of Bartlett and Anjou pears in the standard polyethylene and in the "high slip" type of polyethylene bag liner. Both types were satisfactory for extending the storage life of pears at 30°F.

This project to be superseded by another on pear packaging.

17. Sealed Polyethylene Lug Liners for Sweet Cherries

MRD-BSB

Approximately 80 percent of the current limited sweet cherry crop in the Northwest was packed in sealed polyethylene film lug liners. Aging, shriveling, and decay in cherries are markedly reduced without impairment of dessert quality by using sealed poly liners in 15-pound wooden lugs.

This project will be terminated upon completion of the current studies.

18. Polyethylene Liners for Table Grapes

MRD-BSB

Previous experiments with film liners indicated that grapes must be exposed periodically to sulfur dioxide during prolonged storage to maintain attractive stems and suppress decay. The use of sealed plastic film liners prevented moisture loss but prevented the usual treatment with sulfur dioxide. This year the inclusion of 20 grams of 50 percent sodium bisulfite-silica-gel mixture in the sealed liners effectively controlled decay of Emperor grapes and preserved the appearance of stems. Perforated fiberboard boxes laminated on the inside with polyethylene were not satisfactory for grape storage.

Experiments will be repeated to verify the findings and to determine the best quantity of sodium bisulfite-silica-gel mixture to include in the liners.

19. Maintaining Quality of Shelled Nuts in Transparent Packages

MRD-BSB

The purpose of this work was to develop methods of increasing the shelf life of shelled walnuts, pecans, and filberts packaged in transparent film. Development of rancidity and darkening are two of the problems. Gas packaging under nitrogen was attempted, using both Saran and Mylar film. Neither of these films was sufficiently impervious to oxygen to permit satisfactory packaging in inert gas.

During the coming year, multiwalled bags of Saran and Mylar, alone or in combination with other films, will be tested for suitability.

20. Suitability of Films for Packaging Dry Beans and Rice

MRD-BSB

This project covers research pertinent to satisfactory packaging of dry beans and rice in 5-pound transparent film bags that will maintain quality and avoid development of off odors, mustiness, and mold. Preliminary packaging tests were made with polyethylene, cellophane, Mylar and other films. The tests uncovered a number of weaknesses in each film and manufacturers already have made considerable headway in correcting them.

Work will be continued with new films which have characteristics to help maintain quality of the product.

21. Prepackaging Eastern Strawberries

MRD-BSB

Strawberries are highly perishable even under the best handling conditions. Film caps on consumer baskets are used increasingly to protect the fruit and eliminate losses from spilling and pilfering. Moisture-proof films were not satisfactory either as caps or overwrap because of heavy condensation, which seriously reduced visibility.

These tests will be repeated with strawberries and with other berries.

22. Effect of Storage Temperature and Polyethylene Packaging on Quality of Strawberry Plants

MRD-BSB

Studies of storage of strawberry plants at 32° and 28°F. packaged in commercial crates and polyethylene lined crates were continued in an effort to extend the storage period.

A commercial nursery in Delaware is now using polyethylene liners for packing plants for late storage, as a result of observing the results of these experiments.

Work with strawberry plants will be continued, and studies on storage of asparagus plants in film-lined crates are contemplated.

23. Polyethylene Bags for Shipping Vegetable Plants

MRD-BSB

As a continuation of work reported last year, shipping tests of bare-rooted tomato and cabbage transplants packaged in polyethylene were conducted in cooperation with the Horticultural Crops Research Branch, ARS, at Tifton, Ga. One of the main advantages of this method of shipping plants is lower express charges. Four to eight $\frac{1}{4}$ -inch perforations provided adequate ventilation for closed film bags containing 50 tomato plants.

This work will be continued. Other kinds of vegetable plants will be shipped in film bags.

24. Handling and Packaging of Pre-Peeled Potatoes

MRD-BSB

To aid a young industry beset by the rapid spoilage of its products, investigations were started with the express objective of lengthening the storage life of packaged pre-peeled potatoes. Microbial activity, greatly enhanced by inadequate refrigeration, was the primary cause of rapid spoilage.

Continuation of experiments on hydrocooling, use of chemical preservatives, effect of perforations in the packages, and keeping quality at different temperatures are contemplated.

25. Polyethylene Liners and Bags Aid in Extending Storage Life of Lettuce and Cabbage

MRD-BSB

Improved packaging techniques have been investigated as part of a project to extend the storage life of vegetables handled in the U. S. Navy supply system. Polyethylene bags and crate liners aided materially in maintaining green color and crispness in lettuce, celery, and cabbage. Nonsealed film bags and liners did not extend storage life, but aided in preserving crispness and color.

This project will be continued.

26. Development of Insect-Resistant Packaging

MRD-BSB

The basic work on this subject has been under way for 6 years at Savannah, Ga. Large-scale tests in cooperation with the Army Quartermaster Corps are also carried out at Savannah.

Preliminary laboratory evaluation tests have been completed on 181 candidate repellent compounds to study their possible value as repellents on paper packages. None showed as great repellency as the standard, synergized pyrethrum, but 74 showed enough promise to carry on to the next type of evaluation testing.

The search for a better repellent and for better synergists and stabilizers for pyrethrum will continue.

B. Economic Factors

1. Prepackaging Fruits at Point of Production

MRD-TFB

The purposes are to: (1) Determine economic feasibility of pre-packaging fresh fruits at point of production; (2) develop and evaluate improved packages or methods of prepackaging fruits; and (3) assist producers, shippers, and processors in the development and adoption of more efficient methods and practices in the preparation and distribution of prepackaged fruits.

Peaches.---Research work on the evaluation of prepackaging fresh peaches in cell-type consumer cartons was continued during the 1956 peach marketing season. This work is being undertaken in cooperation with the West Virginia Experiment Station and the South Carolina Experiment Station.

Grapes.---Three types of 2-pound consumer packages for Thompson Seedless and Emperor grapes were evaluated during the 1956 marketing season. The work was done in cooperation with several grape shippers in the central California area.

The use of cellophane versus cellulose acetate film for overwrapping grapes in trays also was evaluated. Prepackaging grapes appears quite promising because it is possible that reduction in retail waste and spoilage losses and increased efficiency in retail handling will offset the increased cost of packaging grapes at shipping level.

Work on prepackaging grapes will be continued during the 1957 season to evaluate newly introduced packages and assist in developing more efficient packaging methods.

Apples.---Studies were initiated recently on the development of consumer packages for medium size to large apples in cooperation with the Washington State Apple Commission and the Washington Experiment Station, although no results are yet available.

It is planned to continue work on prepackaging of peaches in cooperation with the South Carolina, West Virginia, and California Experiment Stations, with major emphasis on southern and eastern peaches.

Work on prepackaging large apples will be continued and it is also hoped that some additional work can be given to the development and evaluation of consumer packages for plums, prunes, Bartlett pears, and oranges.

2. Prepackaging Vegetables at Point of Production

MRD-TFB

The purposes are to: (1) Determine economic feasibility of prepackaging fresh vegetables at point of production; (2) develop and evaluate cheaper packages and methods of prepackaging fresh vegetables; and (3) assist producers, shippers, and processors in the adoption of more efficient methods in the preparation and distribution of prepackaged fresh vegetables.

Work has been completed and manuscripts have been prepared on prepackaging Florida broccoli, cauliflower, sweet corn, and western carrots. Preliminary studies were initiated on potatoes in Maine and California. The most commonly used consumer packages in Maine were 10- and 15-pound multiwall paper bags and 5- and 10-pound polyethylene bags, and 10-pound mesh bags. Preliminary studies also were made on packaging California Long White potatoes in 10-pound paper bags in the spring of 1956.

Studies of the costs and efficiency of prepackaging potatoes by different methods and in different types and sizes of packages will be continued during the coming year.

It also is planned to initiate studies to evaluate new types of packages for celery and cauliflower. It is planned to evaluate the use of alternative packages and methods of prepackaging celery and cauliflower in order to develop more efficient packaging operations and less costly packages.

3. Prepackaging Fruits and Vegetables at Central Point

MRD-TFB

The purposes are to: (1) Determine economic feasibility of prepackaging produce at central points, primarily terminal markets; (2) develop and evaluate improved packages or methods of packaging; and (3) assist packagers and distributors in the preparation and distribution of produce prepackaged at central point level.

Studies have been completed on prepackaging tomatoes, spinach, and kale. Studies are under way to develop efficient methods of prepackaging pears, and to determine the additional costs involved, the salability, spoilage losses, and cost of retailing as compared with nonpackaged pears. Special emphasis will be placed upon ripening the pears before prepackaging.

4. Survey of Fresh Produce Prepackaging in the United States

MRD-TFB

The purposes are to determine present status of produce prepackaging at central points and grower level by obtaining information on (1) quality of each commodity prepackaged; (2) type, size, and cost of consumer packages and master containers used for each commodity, (3) kind and cost of machinery and equipment used, (4) labor costs, (5) methods of packaging, and (6) distribution practices.

This survey was conducted in the Northeastern States in cooperation with Cornell University. A total of 58 packaging plants were surveyed in this area. About 30 commodities were found to be prepackaged on either a volume or experimental basis.

A manuscript has been prepared for publication. The average costs of master containers, consumer packages, labor, and machinery and equipment, as well as information on the number of plants using various packaging methods, are shown in the report.

It is planned to complete the survey in other areas of the U. S. during the 1956-57 year and publish a report covering the entire survey. This survey is limited to the prepackaging of fruits and vegetables done primarily by centralized packaging plants, and it is not now planned to extend the survey to cover prepackaging done in retail stores or in production areas.

5. Development of Improved Loading Methods and Adaptation of Containers to Proper Loading of Agricultural Products

MRD-TFB

The purposes are to: (1) Develop and evaluate new and improved loading methods for various agricultural products; (2) study the adaptability of different types of containers to the best loading methods; and (3) work with interested groups to secure the adoption and use of the most efficient loading methods.

Tomatoes.--The work on this project, which has been under way for 2 years, is about 90 percent complete. The remaining field work was to be completed with additional test shipments from California during the current year. It is expected that preparation of a report covering the results of this work will then begin.

Peaches.--The work begun on this project during the 1954 shipping season with rail shipments of Georgia and South Carolina peaches in bushel and half-bushel baskets was continued during the 1955 season on shipments of peaches in bushel baskets from Colorado and fresh prunes from Idaho. The objective was to develop a loading method that would reduce container damage and associated fruit bruising, and also provide other shipping economies for many commodities normally shipped in tub baskets of various sizes. Results have indicated that the alternately inverted loading method for baskets will reduce container damage during rail transportation by about 80 to 90 percent, and that inverting, or turning every other basket upside down, will produce little or no significant increase in fruit bruising.

The field work on this project has been completed and the preparation of a report on the results was to be started within the current year.

6. Reduction of Transit Damage and Transportation Costs Through Use of Master Containers, Pallets or Unitized Loading Methods

MRD-TFB

The purposes are to: (1) Develop, evaluate, and measure the potential savings of shipping certain agricultural products in bulk in large pallet-type containers; and (2) develop palletized and unitized loading methods for certain existing types of shipping containers.

Work on this project was begun on a limited scale during the past year with shipments of potatoes in bulk in pallet containers from points in Maine to the Washington, D. C., market.

It is planned to expand work on this project during the coming year to include more shipments of potatoes by rail and by truck from Maine and Long Island to various terminal markets, and also to include shipments of oranges by rail and motortruck from Florida to northern markets.

7. Development and Evaluation of Cheaper and Improved Containers for Fresh Western Plums

MRB-TFB

The purposes are to: (1) Develop improved containers in cooperation with container manufacturers; (2) evaluate new containers as compared with conventional containers from standpoints of (a) container cost, (b) labor requirements, (c) suitability for handling, stacking, storing, and loading, (d) effect on salability of plums, (e) quality and condition of plums as measured by Inspection Service, (f) trade and consumer acceptance, and (g) net returns to growers.

Four years of research and testing have resulted in the development of new plum shipping containers which are now being tried out on a commercial basis. The development was made possible by the wholehearted cooperation of private industry, container manufacturers, and fruit packers and shippers.

The new containers are cheaper and easier to pack than the conventional wood 4-basket crates.

8. Development and Evaluation of Cheaper and Improved Containers for Fresh Pears

MRD-TFB

The purposes are to: (1) Develop improved containers in cooperation with container manufacturers; (2) evaluate new containers as compared with conventional containers from standpoints of (a) container cost, (b) labor requirements, (c) suitability for handling, stacking, storing, and loading, (d) effect on salability of pears, (e) quality and condition of pears as measured by the Inspection Service, (f) trade and consumer acceptance, and (g) net returns to growers.

Only limited work was undertaken in 1956 while results of research work aimed at preventing skin discoloration were awaited. The University of California packaging research personnel undertook to determine the cause of discoloration of pears packed and shipped in fiberboard shipping containers.

It is planned to make test shipments of pears in 1957 to check 1956 experiments' results on the use of various types of pads and other material such as shredded polyethylene and polyethylene discs and various types of packs.

9. Development and Evaluation of Cheaper and Improved Containers for Fresh Fruits and Vegetables

MRD-TFB

The purposes are to: (1) Develop improved containers in cooperation with container manufacturers; (2) evaluate new containers as compared with conventional containers from standpoints of (a) container cost, (b) labor requirements, (c) suitability for handling, stacking, storing, and loading, (d) effect on salability of product, (e) quality and condition of product as measured by Inspection Service, (f) trade and consumer acceptance, and (g) net returns to growers.

Lettuce containers.--Research work on the evaluation of alternative types and sizes of fiberboard boxes for shipping western head lettuce, carried out under contract with the Western Growers Association, was completed during the year. Two hundred carloads of lettuce were inspected upon arrival in eastern markets. Seven types of containers were evaluated. These studies indicate that the lettuce industry might well adopt one container for shipping head lettuce to attain the economies of standardization, although any one particular dimensional size of container would not be entirely suitable for all different sizes of head lettuce.

Avocado containers.--In cooperation with the Administrative Committee of the Avocado Marketing Agreement, preliminary studies were made on 6 types of avocado containers during the 1955-56 marketing season.

Additional studies to evaluate alternative types and sizes of avocado containers will be undertaken during the 1956-57 year.

Shipping containers for prepackaged carrots.--Wirebound crates are most commonly used for shipping carrots prepackaged in 1- to 2-pound film bags. Three-ply multiwall paper bags and 3-mil polyethylene film bags are being used to a limited extent. Although the wirebound crates are generally preferred by the receiving wholesalers because of their sturdiness, ease of opening and reclosing, ability to stand icing, and other factors, they cost approximately \$1.00 and \$1.45 more per carload, respectively, than paper bags or polyethylene bags. The wirebound crates cost approximately 41 cents as compared with 12 cents for the paper bag and 18 cents for 2 smaller polyethylene bags. The large receivers, particularly chain-store warehouses, find that paper bags are entirely suitable for their operation, although the independent wholesalers prefer the wirebound crates or the polyethylene bags because they are more suitable for their method of distribution.

Shipping containers for California Long White potatoes.--Preliminary studies were initiated in 1956 to evaluate shipping containers for California Long White potatoes. Most of these Long White potatoes are shipped in 50- and 100-pound burlap bags. These potatoes frequently arrive in the markets badly bruised, giving them a poor sales appearance in the retail stores. The California potato industry was particularly interested in evaluating newly developed fiberboard boxes for shipping potatoes as a means of better protecting them in transit.

Shipping containers for cantaloups.--Observations were made on the arrival condition of cantaloups which were commercially packed and shipped in fiberboard boxes. Some wholesale receivers reported that cantaloups in fiberboard cartons sold at a discount and other receivers reported no difference in the prices received for cantaloups packed in fiberboard boxes as compared with wooden crates.

No additional work is planned on the evaluation of shipping containers for head lettuce other than to prepare a publication covering results. More work is planned on the development and evaluation of improved shipping containers for potatoes, avocados, melons, and leafy vegetables.

10. Development and Evaluation of Shipping Containers for Frozen Foods, Including Frozen Poultry and Meats

MRD-TFB

The purposes are to: (1) Develop new or improved containers in cooperation with container manufacturers and evaluate them in comparison with conventional containers; and (2) encourage general adoption by the industry of the containers found most suitable.

About 10 turkey processing plants and 10 frozen storage warehouses were visited to evaluate presently used containers for packing and shipping frozen eviscerated turkeys. Sixty-nine different types or sizes of containers were found in use in the 10 turkey processing plants visited. This multiplicity of sizes and types of containers causes serious problems in warehousing and storage, resulting in operating inefficiencies, container failure, and damaged turkeys. The most common type of damage to the turkeys was abrasion damage to the elbows and wings of the birds as well as lesser amounts of abrasions on other areas of the turkey. Punctures were also common, as were other defects such as inefficient vacuum, bridging, poor seal, tears, and broken seams.

It is planned to continue this study to secure and catalog additional data on the types and sizes of containers being used for frozen turkeys and the amount of container damage and product damage associated with the various containers in use.

11. Development and Evaluation of Shipping Containers for Ice-Packed Poultry

MRD-TFB

The purposes are to: (1) Develop new or improved containers in cooperation with container manufacturers, and evaluate them in comparison with conventional containers, and (2) encourage general adoption by the industry of the containers found most suitable.

Wirebound crates are now generally used for shipping fresh ice-packed poultry.

New types of containers are constantly being developed by container manufacturers. The use of these newly developed alternative shipping containers for ice-packed poultry should be investigated by making test shipments to evaluate their economic feasibility as well as their effect upon preservation of the quality of the poultry. These economic studies would cover the cost of alternative containers, comparative labor costs to pack and handle them, cost of ice needed to refrigerate and humidify the chickens, suitability for loading, warehousing, and handling at wholesale and retail levels, and trade acceptance, as well as effects upon the quality of the product.

12. Consumer Packaging of Fluid Milk

MRD-TFB

The purposes are to: (1) Develop more efficient packages for fluid milk products; and (2) evaluate new or improved packages which may reduce the cost of packaging or distributing milk or expand outlets for fluid milk products.

Preliminary investigations were made to determine the present status and need for research work in the milk packaging field.

New materials, including the latest products in the field of plastics, are being tried. Although not yet completely proved, some of these containers are now in the development stage where they merit critical comparative evaluations. It is planned to make evaluations of these newly developed containers first in the school milk program and later in other fields. Packaging of milk for the school milk program was selected for initial research because (1) this market area has homogeneous requirements, (2) it is growing rapidly, and (3) the containers used and the methods of service give little evidence of any trend to standardization.

III. DEVELOPMENT AND EVALUATION OF CONTAINER MATERIAL

1. Container Development and Evaluation

FS

During the past year a report was completed on "Condition of Preservative Treated Field Boxes After Five Years of Outdoor Exposure." Unfortunately there did not appear to be any correlation between the condition of nails, effectiveness of anti-decay treatment, and resistance of the boxes to tests for diagonal distortion.

A quality standard for container wood has been prepared defining three classes of wood parts for boxes, crates, pallets, etc. This is not a lumber grading rule. It specifies the wood quality required for the various parts of boxes, crates, pallets, etc.

A method was developed by which the compressive strength of a box can be predicted from simple tests on the component paperboard sheets.

A simplified method of selecting and designing packaging cushioning materials was developed.

Lateral displacement tests indicated that three auto-nails are required to equal the strength of two regular nails.

Another study had to do with the relative performance of clinching nails on the plywood side of cleated plywood panels as compared to clinching on the cleatside.

A crate bulletin and several crate specifications are currently in process.

During the coming year work will be continued in nailing investigations.

Additional drop tests will be made with a variety of fiberboard boxes for the purpose of studying the influence of kind of load and shape of the box on its rough-handling characteristics.

Further work will be done on an impact tension tester to incorporate various refinements in its operation.

Work will be continued with auto-nails used in fabricating the panels of cleated paper-overlaid veneer boxes. Another study involving the use of staples in cleated plywood and cleated fiberboard boxes will be started.

A survey of pallet use and manufacture will be made, preparatory to a study of rational pallet design and construction.

2. Wheat Straw Corrugating Board

ARS--NUB

Important improvements in quality of straw corrugating board have been made in recent years and they reflect the adoption of research findings at the Northern Branch in the late 1940's. Significant increases in crush resistance, bursting strength, and tensile strength of commercially produced corrugating board over the past 10 years have been observed. These observations are the subject of a manuscript, "Wheat Straw Corrugating Board--An Improved Product," which has been prepared for publication.

New phase studies on wheat straw have been initiated to determine the influence of pulping chemicals on the physical and chemical characteristics of wheat straw pulps for the manufacture of corrugating board, to correlate pulping conditions and pulp characteristics with board properties, and to improve yield, quality, and economics of strawboard production for use by the container industry.

IV. OTHER INVESTIGATIONS RELATING TO PRODUCTION AND USE OF CONTAINERS1. Improved Handling Methods and Distribution Practices for Packaged Produce in Retail Stores and Chain Store Warehouses

MRD-TFB

The purpose is to develop improved work methods, equipment, layout, store organization, delivery methods, packaging methods and materials, and internal operational and managerial practices for handling and distributing prepackaged produce through chain-store warehouses and retail stores.

Improved trimming methods for all major produce items were developed which increased trimming productivity time 26 percent for lettuce, 41 percent for celery, and 18 percent for corn when new methods were taught. Improved trimming workplaces were developed which reduced space requirements by 26 percent and reduced trim handling by 18 percent.

Research now under way at the retail level will be completed. Studies recently begun on developing efficient practices of prepackaging and handling produce in the chain-store warehouses will be continued.

2. Wholesale and Retail Distribution of Packaged Dairy Products

MRD-TFB

The purpose is to develop improved work methods, workplace arrangements, materials, and equipment for packaging and distributing dairy products at the wholesale and retail levels.

A preliminary survey of current handling practices in retail stores has been made and some detailed data from one firm have been obtained.

More intensive study of the dairy operation is scheduled for the coming year.

3. Improved Handling and Distribution Practices for Prepackaged Fresh and Frozen Meat and Poultry Products

MRD-TFB

The aim is to analyze and develop improved work methods, equipment, layout, organization, delivery methods, and internal operational and managerial practices in the prepackaging of fresh and frozen meat and poultry products from the packing plant through the retail store.

A nationwide survey of central prepackaging operations for frozen red meats was completed. It was found that central frozen red meat prepackaging facilities suitably located may achieve substantial reductions in marketing costs.

Information obtained in the survey of central frozen red meat pre-packaging facilities is being used in planning research soon to be undertaken in frozen red meat prepackaging. Research during the coming year in central preparation of fresh meats is being planned around the study of improved methods, equipment, and layout for the performance of carcass blocking and preparation at the warehouse level and the distribution of the resulting meat products to stores.

Three areas of research await an opportunity to make installations of previously developed equipment modifications. They are: (a) Analysis of meat belt line packaging systems; (b) analysis of meat packaging machines; and (c) analysis of a refrigerated packaging line.

Additional research has been done on analysis of labeling machines. The trade has indicated another such machine will presently be on the market which will be included in these studies.

4. Consumer Use of and Opinions About Different Kinds of Pies and Uses of Canned and Frozen Cherries in Pie Baking MRD-MDB

This research project was undertaken in cooperation with the National Red Cherry Institute and was designed to provide background information about homemakers who bake pies, with special reference to those who bake cherry pies.

5. Consumers' Attitudes and Opinions Toward the Packaging and Labeling of Foods MRD-MDB

This study was undertaken in three cities--Atlanta, Kansas City, and San Francisco--to determine consumer reactions towards existing package sizes for frozen and canned foods; uses of and opinions about labeling data; and over-all reactions toward the packaging of these foods. The data have been collected and are now being processed.

6. Marketing Practices and Channels Used by Industrial Feeding Facilities in Purchasing Food MRD-MDB

This study, being made in conjunction with the Market Organization and Costs Branch, is designed to measure the amounts and kinds of foods absorbed by food facilities provided for employees by industrial plants, and to learn management evaluations of the usefulness and importance of these food facilities. Data on packaging will include the types of containers--cans, frozen food packages, bags, etc.--in which the food is bought, size of containers, frequency of purchase, and the relative importance of the different container sizes.

7. Appraisal of Merchandising Practices in Relation to Sales of and Consumer Demand for Butter in Retail Stores MRD-MDB

Part of this research appraised the effect on sales of the use of a pictorial carton for packaging butter as opposed to the use of a non-pictorial carton.

8. Evaluation of Merchandising Practices in Relation to Sales of and Consumer Demand for Cheddar Cheese in Retail Stores MRD-MDB

This study was designed to test and evaluate the effect of the following factors on the sale of cheese in retail stores: In-store packaging, compared with packaging at point of shipment; size of package; and jumbled versus formal displays.

9. Evaluation of Retail Merchandising Practices in Relation to Sales of and Consumer Demand for Fruits and Vegetables MRD-MDB

Carrots.--Consumer response in terms of volume of sales of carrots, with tops removed and packaged in 1- and 2-pound polyethylene bags, compared with carrots displayed in 1-pound bunches with tops on, was evaluated by means of controlled experimentation in retail food stores.

Cherries.--The objective of this research was to measure, in grocery stores, consumer demand for cherries packed in No. 2 cans and in No. 303 cans.

Grapes.--The research on merchandising grapes was conducted by means of a controlled retail store experiment in St. Louis, Mo., to determine the effect that the packaging of grapes has on the retail sales of the product, and to measure consumer acceptance by volume of sales for three distinct types of packages.

Pears.--Part of the research on merchandising pears, carried out in St. Louis, Mo., evaluated consumer acceptance by volume of sales for a package which would lend itself to packaging at a central point with large-scale machinery, and which would provide proper quality from the central point to the retail store, as opposed to a package suitable only for use within the retail store. The results of this work are currently being prepared for publication.

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